REMARKS

New claims 11-48 are currently pending in this application. No new matter is included. Claims 1-10 are cancelled by this Amendment.

DOUBLE PATENTING REJECTION

Claims c1-c10 are provisionally rejected under 35 U.S.C. §101 for double patenting. Claims c1-c10 are cancelled, thereby overcoming this rejection. New claims of differing scope have been added. The Examiner therefore is respectfully requested to remove this rejection.

CLAIM OBJECTIONS

The numbering of the claims is objected to pursuant to 37 C.F.R 1.75(f). Claims c1-c10 are cancelled, thereby overcoming this objection.

Claims c1-c10 are objected to for various informalities. Claims c1-c10 are cancelled, thereby overcoming this objection.

Claim c3 is objected to under 37 C.F.R. 1.75(c) as being of improper dependent form. Claim c3 is cancelled, thereby overcoming this objection.

Claims c9and c10 are objected. Claims c9 and c10 are cancelled, thereby overcoming this objection.

CLAIM REJECTION UNDER 35 U.S.C. §112

Claims c1-c10 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite. Claims c1-c10 are cancelled, thereby rendering this rejection moot.

CLAIM REJECTION UNDER 35 U.S.C. §103

Claims c1-c10 stand rejected under 35 U.S.C. §103(a) as being obvious over Walton et al. (USP 6,493,331) in view of Pierzga et al. (US Published Appln. 2001/0055320), Seki et al. (USP 5,771,224), and Berens et al. (USP 6,272,183). Claim c1-c10 are cancelled thereby rendering this rejection moot.

Regarding new independent claims11 and 33, these claims recite a plurality of Turbo Code encoders and a complex inverse Fast Fourier Transform processor that is coupled to the channel selector for receiving the plurality of first sub-bit streams processed by the plurality of Turbo Code encoders, among other things. New independent claim 34 recites a complex Fast Fourier Transform processor that receives a plurality of complex samples and a plurality of Turbo Code decoders that process the corresponding output from the complex Fast Fourier Transform processor, among other things. New independent claim 35 recites encoding each of the M sub bit-streams independently and performing a complex N-point inverse Fast Fourier Transform for data associated with each of the independently encoded M sub bit-streams to produce an I sequence and a Q sequence of N samples, among other things. New independent claim 42 recites performing a complex N-point Fast Fourier Transform on an I sequence and a Q sequence of N samples to produce N complex point data and iteratively decoding the soft decision values to produce a final hard-decoded bit for each of the M sub bit-streams, among other things. In an exemplary embodiment, the high-speed bit stream is sub-divided into multiple slow-speed sub bit-streams because the slower sub-channel capacity improves the Turbo Codes baseband processor, which performs better at a slower bit rate with a greater number of iterations (see the specification at page 4, lines 14-22). In another exemplary embodiment

illustrated in FIG. 3, the output from each of the plurality of Turbo Code encoders are provided to the complex inverse Fast Fourier Transform processor (see FIG. 3). In yet another exemplary embodiment illustrated in FIG. 4, the output of the complex inverse Fast Fourier Transform processor is process by a plurality of Turbo Code decoders (see FIG. 4).

Walton et la. is directed to a communication system designed to operate with a set of back-off factors that identify the reductions in peak transmit power levels for channels associated with the back-off factors (see the Abstract). Walton et al. discloses a system having a data processor 1412 including a plurality of encoders and a plurality of modulators 1414A-1414R, wherein each modulator includes an inverse Fast Fourier Transform (iFFT) processors 1520A-1520T. As a result, Walton et al. is deficient because it fails to teach or suggest a complex inverse Fast Fourier Transform processor that is coupled to receive the plurality of first sub-bit streams processed by the plurality of Turbo Code encoders. Rather, Walton et al. discloses that each iFFT processor receives an input from only one of the Turbo Code encoders.

Pierzga et al. discloses an OFDM communication system having broadcast providers, earth stations, repeater satellites, and receivers (see the Abstract). The Examiner relies on Pierzga et al. for disclosing a pulse shaping filter (see page 7 of the November 10, 2003 Office Action). Assuming, *arguendo*, that Pierzga et al. discloses a pulse shaping filter, the combination of Walton et al. and Pierzga et al. remain deficient because they fail to teach or suggest a complex inverse Fast Fourier Transform processor that is coupled to receive the plurality of first sub-bit streams processed by the plurality of Turbo Code encoders.

Seki et al. discloses a transmission system that permits the receiving end to demodulate multi-valued modulated symbols successfully under fading conditions and reduces an amount of

transmitted reference data to improve data transmission efficiency (see the Abstract). The Examiner relies on Seki et al. for disclosing an IQ modulator, an IQ demodulator, and an AFC circuit (see page 7 of the November 10, 2003 Office Action). Assuming, *arguendo*, that Seki et al. discloses an IQ modulator, an IQ demodulator, and an AFC circuit, the combination of Walton et al., Pierzga et al. and Seki et al. remain deficient because they fail to teach or suggest a complex inverse Fast Fourier Transform processor that is coupled to receive the plurality of first sub-bit streams processed by the plurality of Turbo Code encoders.

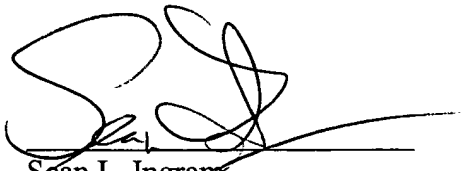
Berens et al. discloses turbo decoding with soft-decision output signals (see the Abstract). The Examiner relies on Berens et al. for disclosing decoding the turbo codes based on using a SISO Map decoder (see page 8 of the November 10, 2003 Office Action). Assuming, *arguendo*, that Berens et al. discloses decoding the turbo codes based on using a SISO Map decoder, the combination of Walton et al., Pierzga et al., Seki et al. and Berens et al. remain deficient because they fail to teach or suggest a complex inverse Fast Fourier Transform processor that is coupled to receive the plurality of first sub-bit streams processed by the plurality of Turbo Code encoders.

Having addressed the foregoing objections and rejections, it is respectfully submitted that a full and complete response has been made to the Office Action and, as such, the application is in condition for allowance. Notice to that effect is respectfully requested.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Dated: May 10, 2004

Respectfully submitted,



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SPECIFICATION

An optimum UMTS Modem for multimedia Data, Voice, VoIP in wireless Internet applications.

Cross Reference to Related Applications

Referenced-applications

~~This patent is based on the development of IP core product for 3G wireless mobile communications by IComm Technologies, Inc.~~ This ~~patent~~ application is related to co-pending U.S. patent application number 09/681093, filed Jan. 2, 2001, and entitled "Turbo Codes Decoder".

Background of Invention

Field of the Invention

[0001] This invention relates to a Universal Mobile Telecommunications System (UMTS) Modem for third generation (3G) Wireless Mobile Communications; and more particularly, to a very high speed UMTS Modem using a Turbo Codes Encoder/Decoder and channel~~s~~ hopping with an Orthogonal Frequency Division Multiplexing method implemented by complex fast Fourier transform (FFT)/inverse fast Fourier transform (iFFT) processors for multimedia Data, Voice, Voice over Internet Protocol (VoIP) in

wireless Internet applications.

Description of the Prior Art

[0002] UMTS stands for a Universal Mobile Telecommunications System. UMTS is ~~a~~ part of the IMT-2000, a global family of 3G mobile communications systems delivering high-value broadband information, commerce and multimedia entertainment services to mobile users via fixed, wireless and satellite Internet Protocol (IP) networks. Modem stands for modulation and demodulation~~s~~. When a base station ~~sending~~ sends digital information to the terminal handset, the modem at the base station converts the digital data into an analog signal and transmits ~~it~~ the analog signal over the air, and the terminal handset modem receives the analog signal and converts the analog signal back into digital data. As shown in FIGURE 1, ~~,~~ digital data from the Media Access Control (MAC) layer 15 is shifted into the UMTS modem transmitter where data is encoded for error-correction.~~, then~~ The data is modulated and sent to the analog front-end 16 for ~~transmitting~~ transmission over the air. Received signals from the analog front-end 16 enter~~s~~

the UMTS modem receiver 13 where ~~it is~~they are demodulated by a baseband processor, then shifted to the MAC layer 15. The Turbo Codes baseband processor is used to encode data and to reconstruct the received data that is corrupted and noisy ~~received data~~ and to improve bit-error-rate (BER) data throughput in a limited power and noisy environment. The Orthogonal Frequency Division Multiplexing is a technique used to divide the broadband channel into sub-channels where multiple adjacent channels transmit their carriers' frequency, which are orthogonal to each other. ~~,~~ T~~t~~he sum of all carriers can be transmitted over the air to the receiver where each channel's carrier can be separated without loss of information due to interferences. FIGURE 2~~.~~ shows an example of an 8-PSK constellations where each group of 3-bit data is mapped in to a point with ~~an~~ in-phase (I) and quadrature-phase (Q) coordinates.

Summary of Invention

[0003] The ~~present~~ invention provides improved methods and architecture of an UMTS modem for delivering optimum high-speed broadband information, commerce and

multimedia entertainment services to mobile users via fixed, wireless and satellite IP networks. The ~~present~~ invention utilizes Turbo Codes baseband processors for optimum performance in decoding received data in limited power and noisy environments. The invention presents a method to divide the UMTS broadband into multiple sub-channels and ~~the~~ uses ~~of~~ an Orthogonal Frequency Division Multiplexing method implemented by N-point complex FFT/iFFT processors ~~in which it~~to effectively divide~~s~~ the broadband high-speed channel into multiple slow-speed N sub-channels where multiple adjacent channels transmit their carriers' frequency which are orthogonal to each other. The high-speed bit-stream is also sub-divided into multiple slow-speed sub bit-streams. ~~An~~ For example, if the total broadband channel capacity is R-Mbps, then the slower sub-channel capacity S-Mbps is equal to (R-Mbps)/N. ~~Therefore, it is most advantageous for~~The slower sub-channel capacity improves the Turbo Codes baseband processor since it performs much better at a~~in~~ slower bit rate with ~~more~~ a greater number of iterations. The ~~present~~ invention utilizes an M-bit serial-to-parallel (S/P) converter to sub-divide~~s~~ the input high-speed R-Mbps bit-stream

into multiple M slow-speed S-Mbps bit-streams, where each bit-stream will be transmitted in the assigned channel. Each bit-stream is encoded one bit per cycle with the Turbo Codes encoder and then mapped into an 8-PSK constellation point where its I and Q components are mapped into the real and imaginary part of the ~~a~~ complex iFFT point. Since M is less than or equal to N, channel hopping can be ~~done~~ accomplished by assigning a bit-stream to a new channel once its current channel ~~getting~~ becomes noisy. Accordingly, several objects and advantages of the ~~present~~ invention are:

[0004] To deliver high-quality, high-speed broadband information to the wireless IP network.

[0005] To utilize the Turbo Codes baseband processor, rate 1/3, 8-state SISO Log-MAP, for optimum performance in decoding received data.

[0006] To utilize an M-bit serial-to-parallel (S/P) converter to sub-divide the input high-speed bit-stream into multiple M slow-speed bit-streams.

[0007] To utilize an Orthogonal Frequency Division Multiplexing method implemented by N-point complex FFT/iFFT processors to sub-divide the broadband high-speed channel into multiple slow-speed N sub-channels.

[0008] To implement channel hopping to re-assign a new channel once the ~~old~~ existing channel ~~getting~~ becomes noisy.

[0009] To utilize a guard-interval (GI) addition to minimize intersymbol interference~~s~~.

[0010] Still further objectives and advantages will become apparent to one skill in the art from a consideration of the ensuing examples, descriptions and accompanying drawings.

Brief Description of Drawings

[0011] FIGURE 1~~. An~~ illustrates an UMTS Modem System Block Diagram (Prior Art).

[0012] FIGURE 2~~. An~~ illustrates an 8-PSK Constellations (Prior Art).

[0013] FIGURE 3~~. An~~ illustrates an UMTS Modem Transmitter Functional Block Diagram.

[0014] FIGURE 4~~. An~~ illustrates an UMTS Modem Receiver Functional Block Diagram.

Detailed Description

[0015] As shown in FIGURE 1, ~~.~~ an UMTS modem 11 comprises ~~of an~~a modem transmitter 12 for modulating digital data and sending the signal over the air, a modem receiver 13 for demodulating received signals

and converting ~~it~~ the received signals into digital data, and an AFC Clock Recovery circuit~~ry~~ for recovering clock and synchronization information.~~.~~

UMTS Modem Transmitter

[0016] As shown in FIGURE 3~~.~~, an UMTS modem transmitter 12 comprises ~~of~~ an M-bit serial-to-parallel (S/P) converter 31 to convert an inputted bit-stream into an M number of sub bit-streams, an M number of Turbo Codes encoders 32 with coding rate 1/3 and constraint length K=4 corresponding to each bit-stream, an M number of Mappers 33 for 8-PSK modulation corresponding to each channel, a Channel Selector for assigning each bit-stream to a sub-channel, an N-point complex iFFT processor 34 for implementing multiple sub-channels with Orthogonal Frequency Division Multiplexing methods, a guard interval (GI) adder 35 for adding guard interval, a Symbol Wave Shaper 36, and an IQ Modulator 37 for ~~modulation~~ modulating the transmitted signal with a carrier, and a Carrier generator 38 that produces a carrier frequency.

[0017] As shown in FIGURE 3~~.~~ and in FIGURE 1~~.~~, the UMTS modem transmitter 12 functions effectively

as follows:

[0018] High-speed R-Mbps input serial data is shifted into the M-bit serial-to-parallel (S/P) converter 31 to generate the slow-speed S-Mbps M ~~serial~~ parallel sub bit-streams (labeled from 0 to M-1).

[0019] Each sub bit-stream is shifted serially into its own Turbo Codes encoder 32, with coding rate 1/3 and constraint length K=4, one bit per cycle where it is converted into a 3-bit symbol output (one data bit and two parity bits).

[0020] The 3-bit symbol 22 is shifted into the 8-PSK Mapper 33 where it is mapped into a constellation point 21 as shown in FIGURE 2. The values of its I and Q components are selected from the Table 1. The output of the 8-PSK Mapper 33 is a set of (I,Q) values that corresponds to the Real and Imaginary parts of a point in the complex iFFT processor.

[0021] The (I,Q) values are shifted into the Channel Selector 39 where each set of (I,Q) is assigned to a point in the N-point complex iFFT processor. When channel hopping is required, the Channel Selector 39 can re-assign a new point for ~~that~~ the requested set of (I,Q).

[0022] The complex iFFT Processor 34 performs the ~~invert~~ complex inverse fast Fourier transform (iFFT) to produce N complex samples which are then separated into an I sequence and a Q sequence of N samples that correspond to the real and imaginary parts.

[0023] The I and Q sequences are shifted completely through the GI Adder 35 where the guard interval is added to each I and Q sequences.

[0024] The I and Q sequences are then shifted completely through the Symbol Wave Shaper 36 where the I and Q sequences are modified by a symbol wave-shaper FIR filter.

[0025] The I and Q sequences are then shifted completely through the IQ Modulator 37 where the I sequence is modulated with Sine carrier 38, and the Q sequence is modulated with a Cosine carrier 38. The summation of the modulated I and Q sequences produces the transmitted signal output.

UMTS Modem Receiver

[0026] As shown in FIGURE 4, ~~:~~ an UMTS modem receiver 13 comprises ~~of~~ an IQ demodulator 41 for demodulating the received signal with a carrier, a local carrier generator 48 produces carrier

frequency, an AFC Clock circuit~~ry~~ 47, a guard interval (GI) remover 42 for deleting guard interval, an N-point complex FFT processor 43 for implementing multiple sub-channels with a Orthogonal Frequency Division Multiplexing method, an M number of de-Mappers 44 for 8-PSK demodulation corresponding to each channel, an M number of Turbo Codes Decoder baseband processors 45 with coding rate 1/3 and constraint length K=4 corresponding to each bit-stream, an M-bit parallel-to-serial (P/S) converter 46 to convert the M input sub bit-streams into a final bit-streams output.

[0027] As shown in FIGURE 4~~.~~ and FIGURE 1~~.~~, the UMTS modem receiver 13 functions effectively as follows:

[0028] Received signals entering the IQ Demodulator 41 ~~is~~ are demodulated with a local carrier 48 to produce the I and Q sequences of N samples.

[0029] The I and Q sequences are shifted completely through the GI Remover 42 where the guard interval is remove from each I and Q sequence.

[0030] The I and Q sequences are then shifted completely into the N-point complex FFT Processor 43. The FFT Processor 43 performs the complex Fast Fourier Transform (FFT) for the I and Q sequences

of N samples to convert them into N complex points of data.

[0031] The Channel De-selector 49 then selects each complex point of data for each set of (I,Q) values that correspond to each of the M bit-streams.

[0032] Each set of (I,Q) is shifted into the 8-PSK De-Mapper 44 where it is converted into a soft-decision value output.

[0033] The soft-decision value data is shifted into the Turbo Codes Decoder baseband processor 45, where data is iteratively decoded until a final ~~dicision~~ decision hard-decoded bit is produced for the output that correspond to each bit-stream.

[0034] The hard-decoded output bit is latched into the M-bit parallel-to-serial (P/S) converter 46, where ~~the~~ all the M-bit data is serially shifted to the output.

Claims

[c1] An optimum UMTS Modem for multimedia Data, Voice, VoIP in wireless Internet applications comprising of:

an UMTS modem transmitter;

an UMTS modem receiver;

an N-point complex FFT processor and an N-point complex iFFT processor for implementing the multiple sub-channels with Orthogonal Frequency Division Multiplexing method;

a Turbo Codes baseband processor for optimum performance in decoding of noisy receive data, and encoding transmit data;

an 8-PSK Mapper for mapping a 3-bit symbol into a point on the 8-PSK constellations with the I and Q component values;

an 8-PSK De-mapper for converting the received set (I,Q) values from the complex FFT processor into soft-decision values for the Turbo Code baseband processor;

an M-bit serial-to-parallel (S/P) converter for segmenting the input bit-stream into an M number of sub bit-streams;

an M-bit parallel-to-serial (P/S) converter for shifting the decoded data to the output;

a Channel Selector and a Channel De-selector for

assigning bit-streams into sub-channels, and also controlling the channel hopping function;

a GI adder and a GI remover for adding and removing guard intervals from the I and Q sequences of samples;

a Symbol wave shaper;

an IQ Modulator for modulating the I and Q sequences of samples and adding them into a transmit signal;

an IQ Demodulator for demodulating the receive signal and producing the I and Q sequences of N samples; and

an AFC Clock Recovery circuitry for clock synchronization.

[c2] The UMTS modem system of claim c1, wherein the Turbo Codes baseband processor uses SISO 8-state Log-MAP decoder for high-speed and optimum decoding a plurality of sequences of the receive samples.

[c3] The UMTS modem system of claim c1, wherein the 8-PSK De-mapper produces soft-decision values output.

[c4] The UMTS modem system of claim c1, wherein the complex FFT/iFFT processors sub-divide the UMTS broadband channel into multiple sub-channels by using the Orthogonal Frequency Division Multiplexing method.

[c5] The UMTS modem system of claim c1, wherein the M-bit serial-to-parallel (S/P) converter sub-divides the high-speed R-Mbps input to generate the multiple slow-speed S-Mbps M sub bit-streams; where S-Mbps is equal

to R-Mbps divide by N.

[c6] The UMTS modem system of claim c1, further provides a method to divide the UMTS broadband into multiple sub-channels and the uses of an Orthogonal Frequency Division Multiplexing method implemented by N-point complex FFT/iFFT processors where multiple adjacent channels transmit their carriers' frequency which are orthogonal to each other.

[c7] The UMTS modem system of claim c1, further provides a method to divide high-speed bit-stream into multiple slow-speed sub bit-streams for transmitting over the sub-channels.

[c8] The UMTS modem system of claim c1, further provides a method to control channels hopping by re-assign bitstream into another sub-channel.

[c9] A method for UMTS modem transmitting a plurality of high-speed digital information generated from a MAC layer into wireless IP networks comprising the steps of:

(1) sub-divide the high-speed R-Mbps input serial data by shifting it into the M-bit serial-to-parallel (S/P) converter to generate the multiple slow-speed S-Mbps M sub bit-streams;

(2) encode each bit of each bit-streams independently with a Turbo Codes encoder, with coding rate 1/3 and constraint length K=4, to generate a 3-bit symbol (one data bit and two parity bits);

(3) map the 3-bit symbol into an 8-PSK constellations points to select the values of its I and Q components;

at this point, all the sub bit-streams are done the same as the above step (2), (3);

(4) select a point in the N-point complex iFFT and map the I component into its real part and the Q component into its imaginary par accordingly;

(5) perform the invert complex N-point Fast Fourier Transform to produces the two I and Q sequences of N samples corresponding to the real and imaginary of the complex iFFT products;

(6) add the guard interval to the I and Q sequences of N samples;

(7) modify the I and Q sequences of N samples with and FIR filter Symbol wave shaper;

(8) modulate the I sequence with a Sine carrier, and the Q sequence with a Cosine carrier;

(9) sum the two modulated I and Q with an adder to produce the transmit signal.

[c10] A method for UMTS modem receiving a plurality of

high-speed digital information received from the wireless IP networks comprising the steps of:

(1) demodulate the receive signal with a local carrier to produce the I and Q sequences of N samples;

(2) remove the guard interval from the I and Q sequences of N samples;

(3) perform the complex N-point Fast Fourier Transform on the I and Q sequences of N samples to convert them into N complex points data;

(4) de-selector each of N complex point data for each set of (I,Q) values correspond to each of the M bit-streams;

(5) de-map each of the M complex point (I,Q) based on an 8-PSK constellations to produce soft-decision values;

(6) decode the soft-decision value with the Turbo Codes Decoder baseband processor, where data is iteratively decoded until a final decided hard-decoded bit is produced for the output correspond to each bit-stream;

at this point, all bit-streams are done with steps (5) and (6);

(7) latch all M decoded bits into the parallel-to-serial converter and shift out to the output.

~~An optimum UMTS Modem for multimedia Data, Voice, VoIP in wireless Internet applications.~~

Abstract of Disclosure

The ~~present~~ invention encompasses ~~several improved methods and architecture of~~systems and methods associated with an UMTS modem for delivering optimum high-speed broadband information, commerce and multimedia entertainment services to mobile users via fixed, wireless and satellite IP networks. The ~~present~~ invention utilizes a Turbo Codes baseband processor for optimum performance in decoding received data in limited power and noisy environments. The ~~present~~ invention provides a method for dividing the high-speed bit-stream into multiple slow-speed sub bit-streams, and also dividing the UMTS broadband channel into multiple sub-channels for transmitting each sub bit-stream in the assigned adjacent sub-channels, and ~~the~~ uses ~~of~~ the Orthogonal Frequency Division Multiplexing method implemented by N-point complex FFT/iFFT processor ~~in which it~~to effectively divides the broadband high-speed channel into multiple slow-speed N sub-channels where multiple adjacent channels transmit their carriers' frequency which are orthogonal to each other. Also, when M

is smaller than N, channels hopping can be done by re-assigning a bit-stream to another sub-channel slot.